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# NANOROBOTS:- CURRENT TRENDS AND APPLICATIONS

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**ABSTRACT**: -Technological advancements post the industrial revolution brought about a number of transformations in the human lifestyle. The last century accelerated the pace of these advancements at a flying mount. These technologicaladvancements have increased the human capability to maneuver the world as per its requirement. One such booming field is that of NANOTECHNOLOGY. Nanotechnology is a science focusing on product innovation,crude material, product attributes, and product utilization by controlling the size of the product to keep it as minute as on a nanoscale (shukla, 2023).In today's time the healthcare realm is more attracted towards usage of less intrusive methods for diagnosis of diseases and precise drug delivery especially in cancer treatment. Here's where nanorobotics comes into play. Nanorobotics is a technologyin which robots produced at a miniature levelat a nanoscale dimensions. These are used to diagnose and cure various diseases with higher rate of accuracy.Nanorobots are significantly used in the diagnosis andtreatment of cancer and osteosclerosis. They have the capability of regenerating dead tissue also Nanorobots help in drug delivery in smaller batches at pinpointed region which might also be at rather distant regions. Nanorobots are capable at executing tasks like detecting, processing data and displaying intelligence at miniscule nanometre

KEYWORDS: -Nanotechnology, Diagnosis, Nanorobotics, Drug delivery.

**INTODUCTION: -**

The theory of nanotechnology was first put up in 1959 by Richard Feynman, a Nobel Prize winning physicist, in a lecture, "There's plenty of room at the bottom". He ended the lecture with remarks on growth of this field saying "this is a development which I think cannot be avoided". (Kumar, S. S., Nasim). Nanotechnology can be explained as depiction of tasks at molecules and atoms level which finds its usage in day-to-day life. Nanotechnology can be a pricy method to carryout processes. Forits cost effectiveness molecular fabrication must be automated and this can be possible through small miniscule sized robots called "Nanorobots". Further development in the fieldsof robotics, nanostructuring, medicine, bioinformatics, and computers can lead to the development of the nanorobot and its most important feature of targeted drug delivery system(Mazumder, S., Biswas). The main constituent in the nanorobot structure is CARBON. Carbon's feature such as its inertness and strength like in the form of diamond makes it best choice as constituent of Nanorobots. To avoid any attack on these Nanorobots from the immune system of the host while its functioning inside the host these robots are covered with a layer of diamond. Theever-growingresearch is in the field of molecular robots, which is the processby whichnature does its things at nano scale (Wang, J.).Mother Nature boasts a collection of molecular mechanisms functioning since and as human mind expands, we desire to establish such mechanisms made from scratch using nature's components. The benefit of using nature'smachines is that these are highly reliable. This review chapter intends to delve into the steadily advancing field of nanotechnology which has the capability to grow into something that breaks the shackles of how we perceive the conventional medicine and its subsidiaries. This paper also probes into integral and basic characteristics of Nanorobots and how it will come to human aid also this scrutinizes into the forthcoming challenges that could be road block in its development.

Nanorobots are the manmade artificially constructed devices so its interaction with the evolving human mind and body can be controlled by internal/external mechanisms. For a better know how of the mechanism of interaction between Nanorobots and living organism highly sensitive and intricatestimulus protocol should be established.Certainly, the usage of conventional

medicinal approaches will be enhanced by the introduction of Nanorobots and revolutionize the diagnostic and treatment proceedings (Beneson Y, 2004).

***PRODUCTION OF NANOROBOT USING 3D PRINTING TECHNOLOGY: -***

The size of nanorobot depends on its task. Nanorobots can be produced using the 3D printing technology at a nanoscale.In this process Nanorobots are carved out with the help of laser etched machine.The production of nanorobot segmentwith the help of laser-based 3D printing increases the quality and accuracy.In 3D printing technology the photoactive resin is used which is hardened with the concentration of laser beam on whichis later hardened by the beam and cutout in the form of nano objects (MB I. , 2010).The material commonly used for nanorobot production is carbon based material like fullerene nanocomposites or carbon nanotubes because of its characteristics like biocompatible tenacity, thermal efficiency and capability to absorb near infrared radiation, also providing continuous therapeutic effects (p, 2016)

***MECHANISM OF MOVEMENT OF NANOROBOTS: -***

The movement of Nanorobots is made possible with the help of artificial molecular motorsattached onto the external surface of Nanorobots which controls their movement and motion. But the functioning of Nanorobots in liquid media still continues to be an area of major concern in the designing procedure.The smooth path is necessary for Nanorobots while mitigating in blood stream, to avoid the damage of healthy cells during oncotherapy necessary actions must be taken. Once the disease has been pin pointed Nanorobots actively move towards the target cells for this mini processor has to be integrated into the nanorobot structure (PATEL GM, 2006) (MB I. , 2010) (a, 2008).In the movement of Nanorobots myosin and kinesin protein families are involved to induce biological locomotion (sp, 2004).In biological nanorobot salmonella typhimurium plays the role to induce locomotion. The motion of these Nanorobots may be controlled by electromagnetic field (behkam, 2007).

Nanorobots can be used in restoration or regrowth of damaged tissue.After the tissue trauma white blood cells are placed into the affected region to combat the trauma in such a scenario owing to the advantage of small size Nanorobots can stick themselves on WBC and reach trauma struck site aiding in early repair by carrying out an intricate process involving steps like activation of receptors on the cell surface. (CAVALCANTI A, 2007)(m, 2008) (PATEL GM, 2006).

**PERKS OF NANOROBOTS OVER STANDARD MEDICAL PROCEDURE: -**

1: Incisions harm tissue layers and is quite painful and takes long time to heal.

2: Delicatesurgeries are not always successful

Nanorobots are useful because: -

1. No/minimal tissue trauma.
2. Less recovery periods
3. Diagnosis and treatment from inside
4. Minimal post operational care

**DRAWBACKS OF NANOROBOTS:**

1: Deployment cost is very high

**NANOROBOTS AND ITS DIFFERENTFORMS**: -

1.1 **Biochip**: The application of nanoelectronics, photography and new biomaterials can be thought the best means to enable the necessary manufacturing technology towards Nanorobots for conventional and traditional medical applications, like surgical instrumentation, testing and treatment via drug delivery (Chen, C., Karsh lev). Nanorobots can be used in and as nanoelectronics devices to enhance remote functioning and enhanced capabilities as for medical instrumentation.

1.2 **Naboots**: These are "nucleic acid robots" tis is an organic molecule-based machine that works on nanoscale level. In this machine biological circuit gate utilize materials likeDNAthat are fabricated as molecular machines to aid targeted delivery of drugs at non feasible parts of human body.

**IDEAL TRAITS OF NANOROBOTS: -**

- SIZE: -0.3 to 5 microns with 1-100 nm parts.
- If Nanorobots are bigger in size they may block capillaries which in turn might adversely affect blood flow.
- Passive diamond exterior to protect machine from host immune attack
- Its distinct quality is of "self-replication" which means these robots produce copy of its own self to replace its part that have been weary since a long time. (Mehra, P.)

**APPLICATION OF NANOROBOT: -**

Nanorobot is an expanding field of science that is finding more and more usage into the human life some of it will be discussed down below.

Studies intended to build biosensors and nano-kinetic devices need to facilitate nano robotics operation and locomotion in medical, are showing progress (Couvreur, P.)

The use of nano robots may evolve biomedical interference with minimal impact and less intrusive surgeries and help patients who need continuous body physical observation, or ever upgrade treatments competencyby predicting diagnosis of possible serious disease much before than it turns fatal (Cavalcanti, A.).

- **APPLICATION OF NANOROBOT IN DENTISTRY**: -

- ***NANOROBOTIC DENTIFRICES***- When these Nanorobots are carried to the surface below the gum with the help of mouth cleaning agents. What this nanorobot then does is digesting and biochemical processing of these organic materials into odourless vapours. These denigrators pick out the other harmful bacteria present on the plaque or on the surface. These dentifrobots are deactivated when gulped down (Mehra, P., & Nanorobotics).
- ***NANOROBOT FOR GENE THERAPY:*** -Medical Nanorobots can come into aid for the treatment of genetic diseases it does so by analysing the DNA and proteins'structure as a reference structure and then any dissimilarity can be edited out.Suspended inside the nucleus of cell a repair vessel carries out its genetic maintenancewhile the nanomachine very delicately unwinds theheavily coiled DNA strand with lower robotic and upper robotic arm in the meanwhile upper robotic arm parts the regulatory proteins from the DNA strand and transfers them into designated port (mustafa hamdi, 2008).The information about the structures of the DNA and protein is stored in the database on a nano computer residing outside the celllinked to cell repair ship by extensive communication link.Any irregularities found in the DNA structure are corrected and protein is added againwhich then recoils into its original shape. The Nanorobots in this context can fight the diseases at molecular and cellular level.
- ***Nanorobotics in cancer treatment***- Nanorobots with bio sensors are used for detecting tumour cells which at later stage can develop into cancer.Nano sensoris responsible detecting presence of malignant cell in the body.The anticancer medications have narrow therapeutic index i.e. the ratio between the dosage that causes therapeutic affect and dosage causes toxic effects.IF drug has narrow therapeutic index, then it means there is a small difference between therapeutic and toxic dosage leading to chances of adverse effect. To neutralize this is when nanorobot comes into play for cancer diagnosis and treatment.One of the common anti-cancerdrugs is **Doxorubicin**.These drugs aid in the killing of rapidly dividing cancer cells. Considering the small size of Nanorobots and its capability to mitigate easily in the bloodstream can be leveraged to diagnose and treat cancer. For detection of tumour cells Nanorobots integrated with bio sensors can be used. Hence formation of such a hardware that is based on the nano bioelectronics is considered at a boon for cancer diagnosis and therapy (luz, 2016).Another method being developed is releasing genetically modified salmonella bacteria which gets attracted to the cancer cells because of their release of a chemical these bacteria carry with them the small Nanorobots which in this case are called biorobots release capsules carrying drugs on the cancerous cells leaving the healthy cells relieving the patients from side effects of chemotherapy (Monika Nijhawan, 2013) (Rohit Kumar, 2014).
- ***NANOROBOTICS' ROLE IN DIABETES TREATMENT:*** -Diabetes is turning to be the most common disease across the world but especially in India owing to the sedentary lifestyle andless activity time.In such a case when diabetes is has many patients and can lead to other health hazards Nanorobots can be a rather faster way to treat such a wide spreading disease. A patient needs to monitor its blood sugar levels all along the day many times. To avoid such kind of inconvenience medical Nanorobots can be used. For this a simulated nanorobot prototype model is used which has COMPLIMENTARY METAL OXIDE SEMICONDUCTOR (CMOS)nano bioelectronics due to its small size of around 2 micrometres it can mitigate easily in the blood stream. For the detection of levels of blood sugar, the Nanorobots has embedded chemo sensor that regulates action ofhSGLT3 protein. This aids nanorobot to asses weather the patient requires insulin dosage or any othermedication mitigating in the bloodstream these robots also keep on checking blood sugar levels. Medical Nanorobots allows the passing of important datasets in the mobile phone using Rf signals.If sugar level increases, then this sends alarm in the mobile phone (sneha sabu, 2018).
- ***NANOTECHNOLOGY IN CURE OF NEPHRO DISEASES***: - Kidney stones are very common disease that is extremely painful. These large stone donot pass the urine making it extremely unbearable. Nanorobots break these stones with the help of laser beam that breaks these stones into small pieces making it easily passable through urine.

***FUTURE SCOPE:***

There is abundance of fields in which Nanorobots can be brought into use. One such field is that of eye surgery where Nanorobots can do the precise operation of eyes with least chances of error also prevent loss and damage of small eye tissues.

Another such field is that of biotechnology where Nanorobots can come into use is of biotechnology where it can play role more on information delivery and less on diagnostics and cure of diseases.

***CONCLUSION: -***

The rapidly increasing patients of diseases like cancer of which treatment comes with higher rate of side effects in such scenarios new age technology like nanorobotics has a huge potential todominate a larger chunk of medicine domain. In the coming years they can also get a breakthrough in the product development. Efficient Nanorobots come in aid of age reversal procedures more efficiently and less repercussions. Nanorobots can be brought into industrial usage.They can provide personalizes diagnosis and treatment specific to a person's own health condition and particular apprehensions. Nanotechnology has an ability to change the face of not only medicinesother relating fields like pharma, biotech, diagnostics etc.Highest impact can be expected on the major diseases like cardiovascular diseases, cancer,musculoskeletal diseases, viral diseases.Nanorobotics is single handedly a big boon for the field of medicines but it's disadvantages still needed to be sorted out. Hence extensive research must be carried out to mould the technology of nanorobotics into our life seamlessly.

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